Reliability of nutritional assessment in patients with gastrointestinal tumors

Confiabilidade da avaliação nutricional em pacientes com tumores gastrointestinais

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ABSTRACT

Patients with gastrointestinal cancer and malnutrition are less likely to tolerate major surgical procedures, radiotherapy or chemotherapy. In general, they display a higher incidence of complications such as infection, dehiscence and sepsis, which increases the length of stay and risk of death, and reduces quality of life. The aim of this review is to discuss the pros and cons of different points of view to assess nutritional risk in patients with gastrointestinal tract (GIT) tumors and their viability, considering the current understanding and screening approaches in the field. A better combination of anthropometric, laboratory and subjective evaluations is needed in patients with GIT cancer, since malnutrition in these patients is usually much more severe than in those patients with tumors at sites other than the GIT.


INTRODUCTION

Currently, cancer is a major public health problem worldwide1. In addition, malnutrition and subsequent weight loss have long been among the leading causes of morbidity and mortality, as well as increased costs with other organs dysfunction associated to cancer patients undergoing surgery2. Malnutrition is defined as the energy, protein and other specific nutrients deficient state, which significantly modifies organic functions3.

Patients with gastrointestinal malignancy undergoing major elective procedures have a higher risk of postoperative complications and alterations resulting from their pre and post-admission nutritional status, particularly related to surgical stress, immune suppression induced by cancer or by blood transfusion. Among these factors, malnutrition is the most important due to its high prevalence and negative impact on clinical outcomes such as longer hospital stay3 and mortality. The latter is much more related to malnutrition than cancer alone and can occur in 20% of cases4. Approximately half of the patients with malignancies has malnutrition, and in the case of gastrointestinal tract (GIT) tumors, the mortality rate varies from 30% to 50%, reaching 80% in cases of advanced pancreatic cancer4,5.

Several nutritional assessment methods can be used5, and must be sensitive enough to early identify changes according to specific nutritional imbalances. The method choice depends on the purpose of the assessment, prognosis or even on the response to nutritional interventions2,4.

However, health professionals find it difficult to use most of the currently validated tools for nutritional assessment, due to limited time, method reproducibility, organization or cost6-8. Thus, all currently considered parameters show some sort of limitation to accurately assess the state nutritional6. In the absence of a gold standard, the option for the assessment tool and nutritional classification will depend on the institution and the target population in question, as well as on the resources available8-10. Although the use of indices and multivariate scores is often regarded as the solution to the lack of standardized and reliable evaluation, this is only a possibility10.
Therefore, in the daily practice of oncology, the definition of an appreciable and simple to apply nutritional assessment tool is necessary to identify nutritional risk patients and thus determine the best approach and appropriate nutritional support. The objective of this review is to present an overview of the methods and tools used to determine nutritional risk, considering the pros and cons when applied to patients with GIT cancer.

**METHODS**

We systematically identified studies on nutritional status of patients with GIT cancer through the PubMed and MEDLINE databases. We researched articles published in the last ten years by combining the terms “nutritional assessment”, “GI cancer”, “gastrointestinal tract”, “gastric cancer”, “oesophageal cancer” and “pancreatic cancer”. We considered for evaluation only complete articles with those terms in English or Portuguese. We identified additional articles from citations in the articles evaluated.

**RESULTS AND DISCUSSION**

**General review of nutritional assessment**

It was in the 1950s that authors first published research related to nutritional assessment procedures. Between 1960 and 1980, malnutrition markers have emerged to evaluate surgical patients and new concepts and nutritional assessment methods have been developed. In the following decades, the researchers analyzed the relevance of functional indices and combinations of clinical and laboratory parameters existing in an attempt to better predict nutritional risk. A new concept of body composition was defined from the use of new and more complex equipment and methods of assessment, but still considering subjective concepts. From the beginning of this century, attempts have been made to demonstrate the nutritional assessment method that would be more accurate and reliable for certain types of patients or specific clinical conditions.

**Subjective methods**

In 1980, Detsky et al. described the Subjective Global Assessment (SGA) used to assess preoperative patients with GIT tumors (n = 202) undergoing major surgical procedures; They have shown that SGA could be easily applied and considered it a valid and reliable method to estimate the surgical patients’ nutritional status.

Other authors have published several articles supporting the SGA in determining nutritional status, which differed from other methods in considering not only changes in body composition, but also functional changes. In addition, SGA is a simple, inexpensive, non-invasive method and can be performed at bedside. Correct guidance on the SGA application is essential, since its accuracy depends on the observer’s ability to detect subjectively significant nutritional changes.

Subsequently, the SGA has undergone modifications and adaptations developed specifically to meet the oncological patient characteristics. Questions about symptoms of nutritional impact and resulting from the tumor itself or from the imposed treatment were included and answered by the patient, becoming known as the Patient-generated SGA (PG-SGA). The main introduced difference was a numerical score that allows to better identify patients at nutritional risk and estimate the time required for re-evaluation.

In some multi-center studies on nutritional assessment of hospitalized patients using SGA, different results have been reported, particularly in patients with GIT cancer. Poziomyck et al. found 66% of malnourished patients in surgical cases of upper GIT tumors, while Braggagnolo et al. showed 77% of malnourished patients in a similar sample.

In another study involving 80 patients with GIT tumors, mainly colorectal, Cid Conde et al. found 50% of malnourished patients in surgical cases of upper GIT tumors, while Braggagnolo et al. showed 77% of malnourished patients in a similar sample.

Wu et al. had higher incidence of complications and longer hospital stay the worse the level of SGA in patients undergoing major procedures for GIT cancer (mainly gastric). These results were also supported by our series of patients with esophageal, stomach and pan-
creas tumors. Moreover, in patients with esophageal or stomach cancer, SGA appears to be associated with the Glasgow Prognostic score (GPS). A study comparing PG-SGA with the Mini Nutritional Assessment (MNA) revealed that these tools seem appropriate to define elderly patients as malnourished. GPS and MNA concepts are described in Score Methods later in the text.

### Anthropometric methods

The accuracy and reproducibility of anthropometric measurements may be affected by the equipment calibration, examiner and parameters used for the predictive equations. Several essentially objective nutritional assessment tools have been used in clinical practice, each with its own characteristics.

Body weight is as simple and commonly used measure in clinical practice. However, it does not discriminate mass from fat, muscle, bone or extracellular fluids. Thus, it must be used with caution, since sharp alterations may reflect changes in hydration status, and not necessarily change in cell mass.

Renehan et al. demonstrated that increased body mass index (BMI) on the order of 5 kg/m² in both genders was strongly associated with esophageal adenocarcinoma. Excess weight, visceral fat and abdominal obesity appears to be more disturbing than subcutaneous fat, and any further increase in BMI confers increased risk of developing colorectal cancer, which, however, has not been confirmed in other studies with this tool.

Functional markers are of particular importance, since they correlate well with clinical complications. They may be more sensitive and relevant indicators of changes in nutritional state or response to additional support in the short term than conventional methods. Loss of muscle function is indicative of malnutrition, particularly the loss of lean body mass. Usually expressed by the handgrip strength, it is important to determine the function and the ability of skeletal muscle. The authors consider this as evidence of compromised nutritional status as responsible for the loss of skeletal muscle function and, consequently, loss of

<table>
<thead>
<tr>
<th>Method</th>
<th>Advantage</th>
<th>Disadvantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subjective global assessment (SGA)</td>
<td>Simple, Inexpensive, Non-invasive, Bedside use</td>
<td>Observer dependable, Non-disease specific</td>
</tr>
<tr>
<td>Patient-generated subjective global assessment (PG-SGA)</td>
<td>Simple, Inexpensive, Non-invasive, Bedside use</td>
<td>Provides a good training for observers, Unspecific to different types of cancer</td>
</tr>
</tbody>
</table>
handgrip strength\textsuperscript{8,15,20}. Recently, the measurement of the thickness of the adductor pollicis muscle (APM) was standardized to anthropometric parameters relating to age, gender and physique\textsuperscript{8}. APM has been used to indirectly determine the nutritional status\textsuperscript{14,20,23}, being considered as one of the best single predictors of mortality in a recent study with patients undergoing resection of upper GIT tumor\textsuperscript{8}.

The bioimpedance analysis (BIA) uses the measured phase angle, which is the result of the electric current stored in cell membranes. However, more accurate results depend on regression equations and lower values indicate reduction in cell integrity or cellular death\textsuperscript{24}.

Some authors also use weight loss as a nutritional screening marker. In a study of patients with esophageal cancer, Van der Schaaf et al. found that preoperative loss weight exceeding 10% was associated with a reduction of the overall five-year survival after resection, but not with increased risk of postoperative complications\textsuperscript{25}.

**Laboratory Methods**

Albumin and other proteins used as nutritional markers can be affected by many factors and clinical conditions such as inflammation, malnutrition, diabetes, liver disease or surgical trauma. But they also have been used to assess overall nutritional status, severity, progression and prognosis of the disease\textsuperscript{26}, assuming that plasma levels indeed reflect the rate of synthesis\textsuperscript{27-29}. However, other factors such as liver function, inflammation markers and endocrine stress result in increased levels of cortisol, which also affects albumin regulation\textsuperscript{27}.

Serum albumin has also been described as an independent survival prognostic factor in many tumors, displaying an inverse relation to complications and length of postoperative hospitalization or intensive care, mortality, and resumption of oral intake\textsuperscript{26,27}. Decreased serum albumin also proved to be an independent prognostic factor for cancer patients with unknown primary site\textsuperscript{26}, but further clinical trials are needed to better define the baseline risks in patients with cancer\textsuperscript{26-29}.

Recently, a significant association between increased C-reactive protein (CRP) and poor clinical outcome has been demonstrated in patients with pancreatic cancer\textsuperscript{30}. CRP has also been shown to be an independent prognostic indicator in colorectal carcinoma\textsuperscript{31}.

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**Table 3. Advantages and disadvantages of anthropometric methods.**

<table>
<thead>
<tr>
<th>Method</th>
<th>Advantage</th>
<th>Disadvantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body Mass Index (BMI)</td>
<td>Simple</td>
<td>Does not distinguish fat mass and lean mass</td>
</tr>
<tr>
<td></td>
<td>Inexpensive</td>
<td>Does not reflect body composition</td>
</tr>
<tr>
<td></td>
<td>Non-invasive</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bedside use</td>
<td></td>
</tr>
<tr>
<td>Skinfold Thickness</td>
<td>Simple</td>
<td>Database limited</td>
</tr>
<tr>
<td></td>
<td>Inexpensive</td>
<td>Insufficient correction factors (age, hydration status, physical activity, disease state)</td>
</tr>
<tr>
<td></td>
<td>Non-invasive</td>
<td>No standard for oncology</td>
</tr>
<tr>
<td></td>
<td>Bedside use</td>
<td></td>
</tr>
<tr>
<td>Bioimpedance</td>
<td>Simple</td>
<td>Requires several previous care (4h fasting, use of diuretics, exercise, alcohol intake)</td>
</tr>
<tr>
<td></td>
<td>Non-invasive</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Easy application / Shortly</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Accurate measurements</td>
<td></td>
</tr>
<tr>
<td>Adductor Muscle Pollicis Thickness (APM) / Dinamometry</td>
<td>Simple</td>
<td>Does not evaluate the acute effects of cancer malnutrition</td>
</tr>
<tr>
<td></td>
<td>Non-invasive</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Easy application/Shortly</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Accurate measurements</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Requires the evaluator training</td>
<td></td>
</tr>
</tbody>
</table>
Score Methods

A number of studies have consistently shown that no method or tool alone is enough to predict nutritional status. The mini nutritional assessment (MNA) classified as normal, borderline or malnutrition in the elderly involves anthropometric measurements, overall evaluation, dietary questionnaire and subjective evaluation. A cross-sectional study with elderly patients (n = 109) observed that combined arm circumference (AC) and BMI allowed to predict the MNA classification. In another study evaluating elderly patients with hepatocellular carcinoma, the results suggested that MNA was adequate to identify the risk of deterioration in the quality of life and functional status, and to determine the risk of malnutrition.

The Nutritional Risk Index (NRI) is calculated by the equation of serum albumin and weight ratio; the levels of serum protein and albumin significantly correlated with malnutrition, but not with subgroups of SGA or Nutritional Risk Screening 2002 (NRS-2002). The Glasgow Prognostic Score (GPS) has been used to determine long-term outcome (survival) in cases of curable gastric cancer, according to the degree of inflammation inferred by the CRP and albumin levels, with scores ranging from 0 to 2. It may be useful in determining the nutritional status, since inflammation is a relevant factor in the development of cachexia, though not yet evaluated in the short term.

In a study with 74 patients, 54 (72%) with GIT tumors, the Nutrition Inflammatory Index (NII) was an alternative method for biochemical nutritional assessment and monitoring of patients with cancer and systemic inflammation.

The NRS-2002 is a nutritional and disease severity score, being the preferred method for evaluating patients at risk or malnourished and for selecting those that could benefit from nutritional support. This nutritional screening was directly related to tumor stage in 100 newly diagnosed patients with stomach cancer, and inversely correlated with quality of life, making it a useful tool to identify patients in need of nutritional support throughout treatment.

### Table 4. Advantages and disadvantages of laboratory methods.

<table>
<thead>
<tr>
<th>Method</th>
<th>Advantage</th>
<th>Disadvantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albumin</td>
<td>Simple, inexpensive, independent indicator of survival in many cancers</td>
<td>Unreliable, affected by many factors and conditions, need better definition of baseline risk in cancer patients, reflects more on the severity of the disease than the nutritional status per se</td>
</tr>
<tr>
<td>C-Reactive Protein (CRP)</td>
<td>Independent prognostic indicator for some types of carcinoma, good correlation with other methods of nutritional assessment</td>
<td>Higher costs, alone is not cancer-specific</td>
</tr>
<tr>
<td>Pre-albumin</td>
<td>Sensitive stress level, good marker for visceral protein</td>
<td>Higher costs, non-disease specific, can be affected by non-nutritional factors (reduction in inflammation)</td>
</tr>
<tr>
<td>Retinol Binding Protein (RBP)</td>
<td>High sensitivity to protein and caloric restriction</td>
<td>Higher costs, few studies in cancer patients, potential confounder in vitamin A deficiency</td>
</tr>
<tr>
<td>Total Lymphocyte Count (TLC)</td>
<td>Associated with weight loss and visceral protein loss</td>
<td>May be affected by tumor type and use of chemotherapeutic drug</td>
</tr>
</tbody>
</table>
In 2011, Argiles et al. presented a new tool called “The Cachexia Score” (CASCO), which considers weight and loss of lean body mass, anorexia, inflammatory, immunologic and metabolic disorders, physical performance and quality of life. The score (up to 100) appears to be adequate, although further prospective studies are needed to better define its sensitivity and specificity in different types of cancers, including GIT tumors.39

**FINAL CONSIDERATIONS**

Various methods have allowed measurements of body composition, protein and lipid reserves by traditional anthropometry with the use of more sophisticated equipment. Currently, the most accurate techniques for assessment of nutritional status are more expensive, less available and inappropriate for repetitive measures.2

Many studies have also revealed the inadequacy of any tool or method used alone in safely predicting the nutritional status of patients with cancer, which clearly demonstrates the lack of a specific measure as the gold standard.3,8, although the real need for a specific pattern is questionable. Still, this led to the attempt to combine evaluation measures, such as anthropometric and laboratory data, in order to increase sensitivity and specificity.30, and thus to more adequately evaluate oncology and surgical patients. Overall, the assessment instruments routinely used do not consider the risk and complications of ongoing cancer treatment, such as chemotherapy and radiation, their side effects in the gastrointestinal tract or post-operative implications of the inflammatory response in cancer patients in general.

This is even more relevant when considering patients with GIT tumors, for whom there is no consensus on the best tool or method to assess nutritional status, especially those with upper GIT tumors, most severely affected by nutritional and immune deficiency, and by the effect of major surgical procedures and complications in the immediate postoperative period when compared with lower GIT tumors cases. Probably the course of nutritional depletion between the two tumor locations is very different, as are quite distinct the nutritional support requirements. Thus, attempts to develop new protocols, trials, scores or new combinations of more specific approaches are necessary to better assess the nutritional status in patients with GIT tumors, especially considering those patients with upper GIT tumors, who are more malnourished, more immunocompromised and at increased risk of morbidity and mortality, as recently demonstrated in our series.8 To date, as far as we know, there is insufficient data to establish a consensus for this group of patients. Therefore, it would be interesting to simulate, add or combine features already validated with objective variables to test a single questionnaire specifically designed for the assessment of nutritional status in patients with GIT tumors, especially those with upper GIT tumors.

<table>
<thead>
<tr>
<th>Method</th>
<th>Advantage</th>
<th>Disadvantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glasgow Prognostic Score (GPS)</td>
<td>Powerful method for diagnosis of nutritional status</td>
<td>Not assessed for short-term outcomes</td>
</tr>
<tr>
<td></td>
<td>Long-term survival in some cancer surgery</td>
<td></td>
</tr>
<tr>
<td>Reilly Nutrition Risk Score</td>
<td>Mix of different approaches in nutritional methods</td>
<td>Adults and children in the same group</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Different types of cancer altogether</td>
</tr>
<tr>
<td>Prognostic nutritional index</td>
<td>Good and accurate</td>
<td>Difficult to obtain the hypersensitivity skin tests</td>
</tr>
<tr>
<td>(PNI)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NUTRA*</td>
<td>Anthropometric, Subjective and Laboratory data targeting GIT cancer patients</td>
<td>Ongoing trial</td>
</tr>
</tbody>
</table>

*Developed by SSORG (Southern Surgical Oncology Research Group)
to better predict postoperative morbidity and mortality in patients with gastrointestinal cancer.

In summary, the GPS score, the PG-SGA and some anthropometric parameters are considered suitable for chronic and cancer patients in general. However, a better combination of laboratory, anthropometric and subjective evaluations is required, considering an instrument more focused in GIT cancer patients, since malnutrition in these patients is much more severe compared with the one in patients with tumors in other locations.

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